

3s. 6d. and half a hundredweight of coke not more than 6d. (at 20s. a ton), or only one-seventh part of the price of gas.

If heating gas was supplied at a much cheaper rate, it would in many cases be advantageous to substitute incombustible matter, such as balls of asbestos, for the coke or anthracite. The consumption of gas would in that case have to be increased very considerably, but the economical principle involved (that of heating the air of combustion by conduction from the back of the grate) would still apply, and produce economical results as compared with those obtained by the gas-asbestos arrangements hitherto used.

To illustrate the efficiency of this mode of heating the incoming air by what is called waste heat, I will show you another application of the same principle which I have made very recently to the combustion of gas for illuminating purposes.

(To be continued.)

### THE RECENT SEVERE WEATHER

IN a recent contribution to the literature of meteorology Mr. E. J. Lowe, F.R.S., endeavours to prove that droughts and great frosts are periodical, occurring at intervals of between eleven and twelve years. In support of this theory he remarks: "There can be no reasonable doubt that the cycles are more than eleven years and less than twelve (more nearly eleven than twelve)," and a table of "great frosts" is given, from which we take the dates for the present century in the same order as printed.

1801—2	1819—20	1860—61
1813—14	1837—38	1856—57
1810—11	1840—41	1870—71

The present year may now be added to the above list.

It will be noticed that there are some variations in the lengths of the intervening periods, but there is at the same time a distinct recurrence of eleven-year epochs.

The great frost of the month just ended will doubtless form one of the main features in the meteorology of the nineteenth century. In the table below are given the average temperatures of the United Kingdom for the three weeks ended January 10, 17, and 24 of the present year, together with the temperatures for the same weeks ended January 12, 19, and 26 of the year 1880. Each year the average for these periods was below the mean seasonal value. The deficiency is given in the fifth and tenth columns.

Districts.	1881.				Below the mean.	1880.				Below the mean.
	1st week.	2nd week.	3rd week.	Average.		1st week.	2nd week.	3rd week.	Average.	
Scotland, East .....	30	24	25	26.3	11.7	33	34	34	35.3	2.3
England, N.E. ....	35	23	25	27.7	9.7	37	32	32	33.7	4.3
England, East .....	36	23	24	27.7	10.7	34	32	31	32.3	6.0
Midland Counties ..	34	21	22	25.7	13.3	35	33	29	32.0	6.7
England, South .....	37	26	26	29.7	10.3	35	32	30	32.3	7.0
Scotland, West .....	33	23	26	27.3	12.0	40	34	33	35.7	4.0
England, N.W. ....	35	25	27	29.0	11.0	38	34	33	35.0	5.0
England, S.W. ....	38	31	28	32.3	10.3	39	38	35	37.1	6.3
Ireland, North .....	35	24	26	28.3	12.0	42	37	31	36.7	4.3
Ireland, South .....	38	27	27	30.7	10.7	43	37	35	38.3	3.3
London .....	37.4	24.2	24.8	28.8	10.3	34.2	32.4	29.1	31.9	7.1

The weather during the above periods was cold in both years, and the deficiency of solar heat is more noticeable, if the figures of the second and third weeks in each year are compared. On several days bright sunshine occurred for several hours, yet at some stations the sunshine was so weak as to fail to mark the recording cards of Prof. Stokes's sunshine recorders.

The weather over the whole of north-western Europe has been generally intensely cold, and on January 28 the temperature at Haparanda (extreme north of Gulf of Bothnia) was reported as being 60° F. below freezing point.

H. W. C.

### THE AURORA OF JANUARY 31

WE have received the following communications on the recent brilliant display of aurora:—

HAVING noticed an auroral light through the mist on the evening of January 30, I looked out last evening, the 31st, and

saw what to me at least was a new appearance. There was a strong yellowish-white auroral light in the north, with an uneven boundary—not a well-defined arch. From it there arose, at intervals of a minute or two, what looked like wisps of luminous mist of an elliptical form, with their longer axes east and west. These chased one another towards the zenith, appearing and disappearing with great rapidity, so that one could hardly say "look!" before they had vanished. Sometimes three or four were flashing out at once. They were of large size, and being unaccustomed to the description of such objects, I know not how to describe their size. They must however have subtended horizontally angles of 45° and more at the eye. This appearance lasted, from the time I first looked out at about 6h. 45m., for about ten minutes or less, and then the appearance gave place to ordinary streamers, yellowish-white at their base and rosy towards their summits.

The flashing lights which I have mentioned suggested to me this idea: One has seen two men shaking a carpet held at two adjoining corners. Their strokes not exactly coinciding, an irregular, undulatory movement is produced, something like the waves of a chopping sea. If a stratum of *something* was in such a state of undulation above the atmosphere, and became visibly luminous where the crests of the undulations dipped down into the atmosphere, it would produce the kind of appearance that I saw.

OSMOND FISHER

Harlton Rectory, Cambridge, February 1

LEST the magnificent auroral display of last evening has not been generally visible, the following short account of it, as witnessed here, may not be unacceptable to the readers of NATURE.

At about 6.15 p.m. indications of the disturbance were noticed in an unusually bright appearance of the sky from the north-east to north-west by west, the light being white, and similar in character to that reflected from the upper part of a bank of fog. By 6.25 the upper limit of this phenomenon had gradually changed into a number of bands, alternately bright and dark, but not well defined, which after another short interval disappeared in a change of the light to a very ruddy tint, accompanied by a kind of throbbing in the north, exactly like rapid repetitions of faint lightning. At this period a great number of parallel bands of light of a beautifully clear salmon tint were extended from the ruddy bank in a southerly direction, those from the north passing beyond the zenith, and losing their definition in a diffused patch of light of the same colour. These bands slowly faded away, but were succeeded by a similar and equally beautiful display at from ten to fifteen minutes later.

About seven o'clock I walked two and a half to three miles in a northerly direction, and found in ascending a slight hill that the fog was sufficiently thick to obscure the stars. This I imagine explains the peculiar bank and thick appearance of the light near the horizon.

The whitish illumination in the same quarter of the sky was still visible at 12 p.m.

JOHN HARMER

Wick near Arundel, February 1

A BRILLIANT aurora borealis has been visible here this evening. It commenced at twenty minutes to seven, extending from west-north-west to a little east of north. The western part was of a deep ruddy colour, extending (at a rough estimate) some 35 or 40 degrees from the horizon, and varied by long white streamers, one of which—nearly due north—reached to within 15 or 20 degrees of the zenith. I was unable to watch it for more than a few minutes, but at half-past ten the sky in the same direction was still remarkably bright.

R. W. TAYLOR

Kelly College, Tavistock, January 31

A VERY brilliant auroral display was visible here last night. There was a short heavy shower of hail and rain at six o'clock, and the sky was entirely overclouded. Thirty minutes later the sky was again clear, and the northern horizon was beautifully illuminated, and broad quivering bands of light stretched from thence upward beyond the zenith, some in unbroken continuity, while others were broken up. Not connected with these rays, and on the south side of the zenith, were frequent flashes of light, usually crescentic in form. The light near the horizon was silvery and moonlight like, but higher up it became much ruddier. I watched the aurora from 6.30 till 7, when I was obliged to go in-doors till 10.30, and then able to observe it again. At that time the light near the northern horizon had greatly increased in brightness, but fewer bands extended

upwards and to a less distance. As I walked home along elevated country roads, the effect produced by a dark sky on one side with a bright sky on the other, as if lighted up by an invisible full moon, was very beautiful.

E. H.

Sheffield, February 1

THE aurora borealis which occurred last night was first visible here at 6 p.m. As is usual, the glow extended in an arc about  $15^{\circ}$  above the horizon, and was of a faint greenish colour.

From it arose frequent streamers of the same colour, having a slow westerly motion: these streamers attained to various heights, one at 6.55 reaching almost to the zenith; their colour, of various intensities, was as a rule greenish, but at times the streamers were of a reddish tint, more remarkably that one which occurred at 5.55, above referred to. At 6.50 the low arc changed its character, becoming irregular, finally assumed the form of a double arc, of which the centres of curvature were north-east and north-west of the place of observation.

At irregular intervals, during the whole of the first half hour, after the first appearance of the aurora, a flickering arc of light would ascend from the lower arc, up to an elevation, in many cases, of about  $80^{\circ}$ . At 7 p.m. the aurora decreased in intensity, and at about nine o'clock had disappeared.

Cirencester, February 1

G. W. PREVOST

### UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—The term's work has been delayed a little by the severity of the weather. Many of the colleges were but half filled on the regular day of meeting.

At the University Museum the following courses will be given during the term:—Prof. Henry Smith lectures on Pure Geometry, and Prof. Barth. Price on Geometrical and Physical Optics. Prof. Clifton will lecture on Terrestrial Magnetism at the Clarendon Laboratory. In this department Messrs. Stocker and V. Jones will lecture on Mechanics, and will give practical instruction in Physics. In the Chemical Department Dr. Odling will continue his course on Organic Chemistry. Mr. Fisher will lecture on Elementary Inorganic, and Dr. Watts on Elementary Organic, Chemistry. The laboratories will be open under the direction of Messrs. Fisher, Watts, and M. Robb. Dr. F. D. Brown will lecture (for the Professor) on Chemical Affinity. In the Physiological Department, in the absence of Dr. Rolleston through illness, there will be practical instruction given by Messrs. Robertson, Hatchett Jackson, and Thomas. Mr. Jackson will lecture on Circulation and Respiration; Mr. Thomas on Comparative Embryology; Mr. Robertson will form a class for Practical Microscopy; and Mr. Lewis Morgan will form a class for Human Anatomy.

The following afternoon lectures will be given in the Museum: Prof. Prestwich will lecture on the Palaeozoic Strata, and Prof. Westwood will give an informal lecture on the Arthropoda. In the University Observatory Prof. Pritchard gives two courses, one on the Lunar and Planetary Theories, the other on General Elementary Astronomy, once a week in the evening.

At the Botanical Garden Prof. Lawson gives a course of elementary botany.

At the Colleges which possess laboratories the following courses will be given:—At Christchurch Mr. Baynes will lecture on Thermodynamics; Mr. Dixon, owing to the illness of Mr. Vernon Harcourt, will continue his course on Inorganic Chemistry. At Balliol Mr. Dixon will lecture on Elementary Electricity and Magnetism; at Exeter Mr. Lewis Morgan will lecture on Histology; at Magdalen Mr. Yale will give a series of practical demonstrations on the Physiology of Circulation and Respiration.

In the School of Natural Science Prof. W. A. Tilden has been nominated as Examiner in Chemistry; Dr. S. J. Sharkey, of Jesus College, has been nominated Examiner in Biology; and Mr. J. W. Russel, of Merton College, has been nominated Examiner in Physics.

An examination for a Fellowship in biological subjects will be held in March at University College. The examination will comprise papers of questions, and practical work in zoology, physiology, and botany, and will begin on Thursday, March 3, at 9 a.m. Intending candidates are desired to send in their names to the Master (if possible) before February 11, with a list of the subjects they offer for examination. They are also invited to mention any original work on which they have been engaged, and to send copies of any original articles or books on

biological subjects of which they are the authors. Candidates are desired to call on the Dean with the usual testimonials and certificates on Wednesday, March 2, between 5 and 6 p.m.

CAMBRIDGE.—The senior wrangler in this year's Mathematical Tripos is Mr. Andrew Russell Forsyth, of Trinity College, born in Glasgow in 1858, and educated at Liverpool College. The next two are Mr. Robert Samuel Heath and Mr. Ernest Steinthal, both also of Trinity.

In connection with the list published in these columns in December, of those who had obtained first class honours in the Natural Sciences Tripos, the following statistics may be of interest:—In the year in which the Tripos was instituted (1851), 6 names appeared in the list; the same number in 1861; in 1871, 14; in 1878, 22; and in 1880, 31 passed the examination, obtaining honours. In 1869, 7 men passed the Special Examination in Natural Science for the ordinary B.A. degree; the number increased to 25 in the Easter examination of 1870; in 1878 it slightly diminished to 22; and in 1880, 16 passed the examination in December. So far as these results go, it would appear that an increasing number of those students who declare for natural science at Cambridge aim at thoroughness in their work, and are not content with that superficial smattering of book knowledge which is considered sufficient in the examination for the Pass degree.

M. FERRY, the French Minister of Public Instruction, has given an important character to the next meeting of the schoolmasters of France. Each of the 40,000 teachers of the 40,000 parishes (communes) is to meet with his fellow-teachers at the proper district towns. There are about 2000 of each of these little assemblies, each of which is to elect a delegate who will go to the chief town of the Department, and all these cantonal delegates are to appoint a department of delegates, who will go to Paris with a memoir written for communication and discussion before the pedagogical congress. All these memoirs are to deal with questions proposed by the Government.

### SOCIETIES AND ACADEMIES LONDON

Royal Society, January 27.—“*Polacanthus Foxii*, a large undescribed Dinosaur from the Wealden Formation in the Isle of Wight.” By J. W. Hulke, F.R.S. (Abstract.)

A description of the remains of a large dinosaur, discovered in 1865 by the Rev. W. Fox, in a bed of shaly clay between Barnes and Cowlaze Chines, in the Isle of Wight. Head, neck, shoulder-girdle, and fore-ribs were missing, but the rest of the skeleton was almost entire. Some of the presacral vertebrae recovered show a double costal articulation. In the trunk and loins the centrum is cylindroid, relatively long and slender, with plano-concave, or gently biconcave ends. Several lumbar centra are ankylosed together, and the hindmost to the sacrum. The sacrum comprises five relatively stout and short ankylosed centra of a depressed cordiform cross-sectional figure. The post-sacral vertebrae have a stout short centrum.

The limb bones are short, their shafts slender, and their articular ends very expanded. The femur has a third trochanter, and the distal end of the tibia has the characteristic dinosaurian figure.

The back and flanks were stoutly mailed with simple, keeled, and spined scutes, and the tail was also sheathed in armour.

The animal indicated by these remains was of low stature, great strength, and probably slow habits. It is manifestly a dinosaur, and is considered to be very nearly related to *Hylaeosaurus*.

Linnean Society, January 20.—The Rev. J. M. Crombie, F.L.S., in the chair.—The proposed alterations in the bye-laws were again successively read, voted for, and confirmed, excepting sect. 2, chap. viii. which was not confirmed.—Portfolios of British sea-weeds and zoophytes, prepared by Mr. W. Smith of Falmouth, were exhibited by the Rev. J. Gould.—A squirrel's nest was also shown and commented on by Mr. Chas. Berjeau.

—A new form of microscopical cabinet designed by Mr. W. Hillhouse of Cambridge was explained by him, its compactness and portability rendering it advantageous to teachers.—Mr. Thos. Christy exhibited some horn-shaped galls growing on a branch of *Pistacia atlantica*, and somewhat similar in appearance to those known in India under the name of “Kalaria-singhi” galls. From the galls a substance exuded not unlike Chian turpentine; Mr. Christy also drew attention to the fruit of the